

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
10 October 2002 (10.10.2002)

PCT

(10) International Publication Number  
**WO 02/080328 A1**

(51) International Patent Classification<sup>7</sup>: **H02H 3/08,**  
H01H 73/02

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(21) International Application Number: **PCT/NZ02/00049**

(22) International Filing Date: 28 March 2002 (28.03.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
510861 30 March 2001 (30.03.2001) NZ  
512789 5 July 2001 (05.07.2001) NZ

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

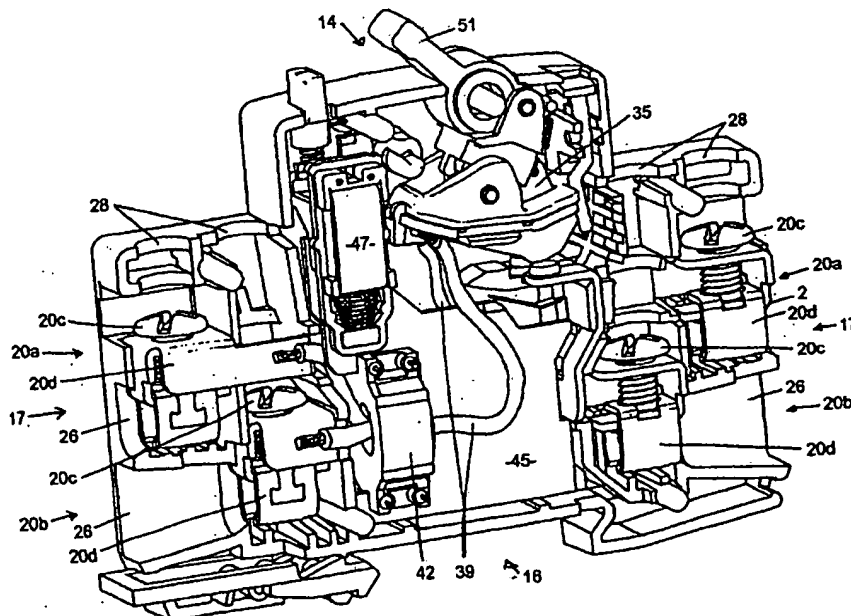
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: AN ELECTRICAL CIRCUIT DEVICE WITH COMPACT TERMINAL CONFIGURATION



(57) Abstract: An electrical circuit device for mounting on a rail or to an electrical distribution board and having two or more terminal connectors (20) at one or both ends has at each end one terminal connector positioned higher in the plane of the depth of the body of the device than the other connector(s) and separately spaced from the adjacent end of the device to compactly accommodate the terminal connectors while still allowing access (28) from the front of the device separately to each terminal connector when fixing conductors to the device.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

5                   **AN ELECTRICAL CIRCUIT DEVICE WITH COMPACT TERMINAL  
CONFIGURATION**

**FIELD OF THE INVENTION**

10   The invention relates to electrical circuit devices such as circuit breakers or switches typically intended to fit within a confined space on an electrical distribution board, and in particular to a compact terminal configuration for connecting electrical conductors to such circuit devices.

15   **BACKGROUND TO THE INVENTION**

Typically, there is a limited amount of space on an electrical distribution board. Further, there are industry standards as to the maximum height, width and depth of units mounted to a distribution board. This is necessarily so because if one unit is removed,  
20   the replacement will need to fit in the remaining space.

Additionally, by convention, the terminals are usually disposed at opposite ends. These are generally quite bulky and this places a further limitation on the usable space within the component. To meet international industry standards the width of each component  
25   is generally limited to 18 mm. Where the unit is to a 2-pole circuit interrupter this width limitation presents difficulties in that the space for each power cable to terminate at the terminals generally takes up the best part of this 18 mm.

**SUMMARY OF THE INVENTION**

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In broad terms the invention comprises an electrical circuit device for mounting on a distribution rail or to an electrical distribution board, including a body having a front, a base, and two sides between the front and the base, and two ends, length between the two ends, depth between the front and the base, and thickness between the two sides,  
35   and two or more terminal connectors housed at or towards at least one end of the body of the device and in which the thickness of the device is insufficient to enable the two or more terminal connectors to be housed side by side across the thickness of the device, wherein at said at least one end or at each end of the body of the device one terminal connector is positioned at a different height in the plane of the depth of the body of the  
40   device from the other connector(s) at that end of the device, and said one terminal connector is spaced from the adjacent end of the body and from the other terminal

- 5 connector(s) in the plane of the length of the body of the device sufficiently to enable access from the front of the device separately from said other terminal connector(s) when fixing a conductor to the terminal connectors.

10 In one form the circuit device may include at least two terminal connectors housed at or towards each end of the body of the device, each at a different height in the plane of the depth of the body from the other connectors at that end of the device and each spaced from the adjacent end of the body and from the other terminal connector(s) in the plane of the length of the body of the device sufficiently to enable access from the front of the body separately to each terminal connector when fixing a conductor to each terminal  
15 connector.

Typically the circuit device includes an aperture or apertures to the terminal connectors through the front of the device, an aperture or apertures for conductors in the ends of the device.

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## **BRIEF DESCRIPTION OF THE DRAWINGS**

In order that the invention may be more fully understood, a preferred embodiment is described by way of example with reference to the drawings in which:

25

Figure 1 is a cut-away view of the preferred form device;

Figure 2 is a cut-away side view of the preferred form device;

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Figure 3 is a cut-away view of the opposite side of the device to Figure 2;

Figure 4 is a perspective view of the exterior of the preferred form device; and

Figure 5 is a perspective view of the preferred form device mounted on a rail of an  
35 electrical distribution board.

## **PREFERRED EMBODIMENT OF THE INVENTION**

40 The preferred embodiment device shown in the drawings is a residual current circuit protection device for mounting to a rail on a distribution board, and comprises a body or housing having a front 14 and a base 16 to mount the device on the distribution rail 13

5 of a distribution board 15 (see Figure 5). The base 16 is typically appropriately shaped to fit an industry standard distribution rail 13. The preferred form device is designed to be able to fit into the existing space normally occupied by devices on the distribution rail such as miniature circuit breakers and isolation switches. Set by international industry standards, this space is about 18 mm and thus the width ie the smallest overall  
10 dimension of the device is in this case limited to 18 mm. Furthermore, the overall length of the housing is also limited because there is a limited amount of room on the distribution board 15 as can be appreciated from Figure 5.

The housing has two sides 11 (see Figure 4) between the front 14 and base 16, and ends  
15 17. The housing thus has length between the two ends 17, depth between the front 14 and base 16, and thickness between the two sides 11.

Terminal connectors 20 are provided at either end of the device and it can be seen from Figure 1 that a considerable amount of space is required to house the terminal connectors 20. Typically in a two pole device for example each end of the body of the  
20 device must house two terminal connectors, one for active and one for neutral respectively.

In accordance with the invention at each end one terminal connector is mounted higher than the other in the plane of the depth of the body or housing of the device, and one is  
25 spaced further from the adjacent end 17 of the body of the device than the other, in the plane of the length of the housing sufficiently to enable access from the front 14 of the device separately to each terminal connector when fixing a conductor to each terminal connector. In the preferred form as shown connector 20a at each end is mounted higher than the other and closer to the adjacent end 17 of the device, but in an alternative  
30 configuration the terminal connector which is closer to the end of the device could be the lower of the two, and the other terminal connector could be the one which is mounted higher than the body of the device ie closer to the front 14 of the device.

Apertures 26 are provided in either end 17 of the device to enable conductors to pass  
35 through the housing or body to each terminal connector, and apertures 28 are provided in the front 14 of the device to enable access to the terminal connectors 20 when fixing (or releasing) conductors to each terminal connector. The two apertures 26 at each end and/or apertures 28 in the front face in the preferred form may be replaced by a single larger aperture.

5 In the preferred form as shown each terminal connector 20 includes a threaded fastener 20c which is rotated in a threaded body 20d of the terminal connector to clamp a conductor to the terminal connector, in known manner, and the fasteners 20c comprise screws with a slotted head. A screw driver may be inserted through the apertures 28 in the front of the device to access the threaded fasteners of the terminal connectors when  
10 connecting conductors to (or disconnecting conductors from) the circuit device. Alternatively however the terminal connectors may be of any other type and the aperture or apertures 28 may provide access for a tool of any type required to open or close the terminal connectors 20. For example a tool may be inserted through the front face of the device to prise apart spring mounted-opposed legs of a terminal connector to enable a  
15 wire to be inserted into the terminal connector, which spring legs clamp the conductor and when the tool is removed.

The remainder of the components of the preferred form residual current circuit protection device are housed within a central portion of the housing 12 between the two  
20 end portions 24. The main components include circuit board 45, sensor coil 42, trip device in the form of a solenoid 47, a latch 49, the moveable contact carrier 35 and a reset mechanism including actuator 51. The circuit board 45 is planar in form and is generally aligned with the main plane of the housing 12. The circuit board 45 is disposed approximately centrally relative to the width of the housing. It can be seen  
25 from Figure 1 that the sensor coil 42 has a central hollow core through which the leads 39 pass. The sensor coil 42 is arranged so that the axis of the central core is substantially aligned with the main plane of the housing and in fact extends in the length direction of the housing. Solenoid 47 is elongate in configuration and is arranged with its length and breath dimension generally aligned with the main plane of the housing and its  
30 thickness dimension generally aligned with the thickness dimension of the housing.

In the preferred form device described above there are two terminal connectors at either end of the device but in an alternative form three (or more) terminal connectors may be provided at each end of the device. In the preferred form there are terminal connectors  
35 at both ends of the device but in an alternative form requiring only two conductors connected to a device but within a confined space, two terminal connectors may be provided in the configuration shown at one end of the device only. Where three terminal connectors are provided at both or one end(s) of the device, the three terminal connectors may be spaced at three different heights within the body of the device in the  
40 plane of the depth of the body, and each is spaced differently from the adjacent end of the device, in a step down-like configuration.

5

The foregoing describes the invention in the context of a residual current circuit protection device but other circuit devices intended to be mounted to an electrical distribution board may utilize the terminal configuration of the invention such as other forms of circuit protection devices, switches, an electrical meter, or similar.

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Further, the circuit device using the compact terminal configuration of the invention may be intended to be mounted to a distribution rail such as rail 13 in Figure 5, which is not associated with a surrounding electrical distribution board and while the preferred embodiment device has been described in the context of mounting the device to the distribution rail of a natural distribution board, the invention is not intended to be limited in this regard.

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The foregoing describes the invention including a preferred form thereof and alterations and modifications as would be obvious to those skilled in the art are intended to be incorporated within the scope thereof.

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## 5 CLAIMS:

1. An electrical circuit device for mounting on a rail or to an electrical distribution board, including a body having a front, a base, and two sides between the front and the base, and two ends, length between the two ends, depth between the front and the base,  
10 and thickness between the two sides, and two or more terminal connectors housed at or towards at least one end of the body of the device and in which the thickness of the device is insufficient to enable the two or more terminal connectors to be housed side by side across the thickness of the device, wherein at said at least one end or at each end of the body of the device one terminal connector is positioned at a different height in the  
15 plane of the depth of the body of the device from the other connector(s) at that end of the device, and said one terminal connector is spaced from the adjacent end of the body and from the other terminal connector(s) in the plane of the length of the body of the device sufficiently to enable access from the front of the device separately from each other terminal connector(s) when fixing a conductor to the terminal connectors.  
20
2. A circuit device according to claim 1 and including at least two terminal connectors housed at or towards each end of the body of the device, each at a different height in the plane of the depth of the body from the other terminal connectors at that end of the device and each spaced from the adjacent end of the body and from the other  
25 terminal connector(s) in the plane of the length of the body of the device sufficiently to enable access from the front of the body separately to each terminal connector when fixing a conductor to each terminal connector.
3. A circuit device according to either one of claims 1 and 2 wherein an aperture or  
30 apertures is or are provided to the terminal connectors through the front of the body of the device.
4. A circuit device according to any one of claim 1 to 3, wherein there are two terminal connectors at each end of the device and including at each end of the body of  
35 the device a first aperture through the front of the device to one of the terminal connectors and a second aperture through the front end of the device to the other of the terminal connectors.
5. A circuit device board according to any one of claims 1 to 4, wherein an aperture  
40 or apertures is or are provided to the terminal connectors at said at least one end or at each end of the body of the device through the end of the body of the device.



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6. A circuit device according to any one of claims 1 to 5 wherein there are two terminal connectors at each end of the device and including at each end of the body of the device a first aperture through the end of the device to one of the terminal connectors and a second aperture through the end of the device to the other of the terminal connectors.

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7. A circuit device according to any one of claims 1 to 6 wherein at each end of the device the terminal connector which is highest in the plane of the depth of the body of the device is closer to the adjacent end of the body than the other terminal connector(s).

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8. A circuit device board according to any one of claims 1 to 7 wherein the terminal connectors each include a threaded fastener which is rotated in a threaded body of the terminal connector to clamp a conductor to the terminal connector and which threaded fasteners are accessible through the front of the device by a tool for rotating the threaded fasteners.

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9. A circuit device board according to claim 8 wherein said threaded fasteners comprise screws with a slotted heads accessible through the front of the body of the device.

25

10. A circuit device for mounting on a distribution rail or to an electrical distribution board, including a body having a front, a base, and two sides between the front and the base, and two ends, length between the two ends, depth between the front and the base, and thickness between the two sides, at each end two terminal connectors housed within the body of the device, one higher than the other in the plane of the depth of the body, and one spaced further from the adjacent end of the body than the other in the plane of the length of the device, an aperture or apertures through either end of the body of the device to enable conductors to pass through the ends of the body of the device to the terminal connectors, and an aperture or apertures through the front of the body at each end of the device to enable access to each terminal connector when fixing conductors to the terminal connectors.

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11. A circuit device according to any one of claims 1 to 10 wherein the base of the device is shaped to fit a distribution rail to mount the device on the distribution rail.

40

- 5    12.    A circuit device for mounting to an electrical distribution board according to any one of claims 1 to 11 wherein the device is a circuit interruption device.
13.    A circuit device for mounting to an electrical distribution board according to any one of claims 1 to 11 wherein the device is a switch.
- 10    14.    A circuit device for mounting to an electrical distribution board according to any one of claims 1 to 11 wherein the device is an electrical meter.

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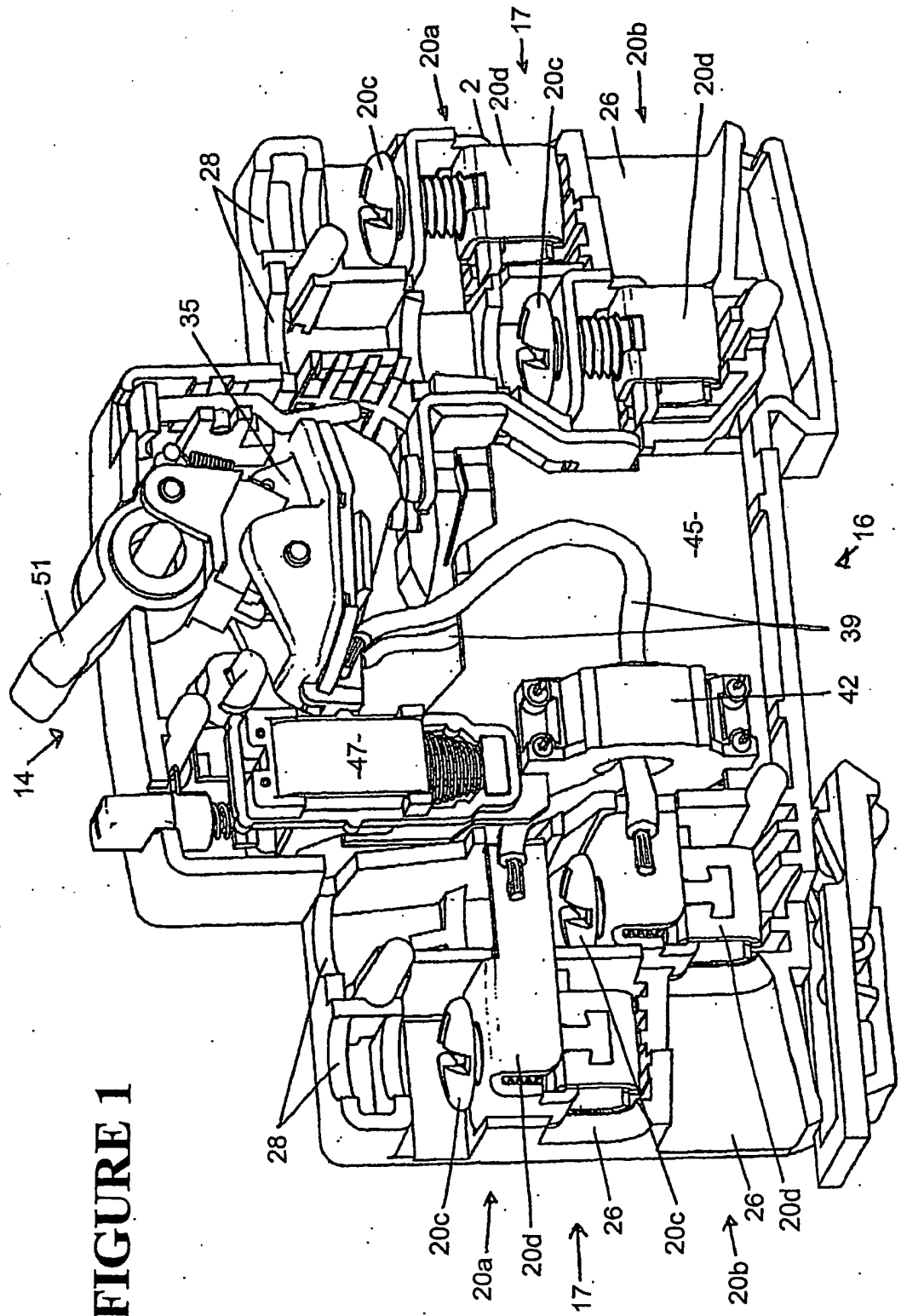


FIGURE 1

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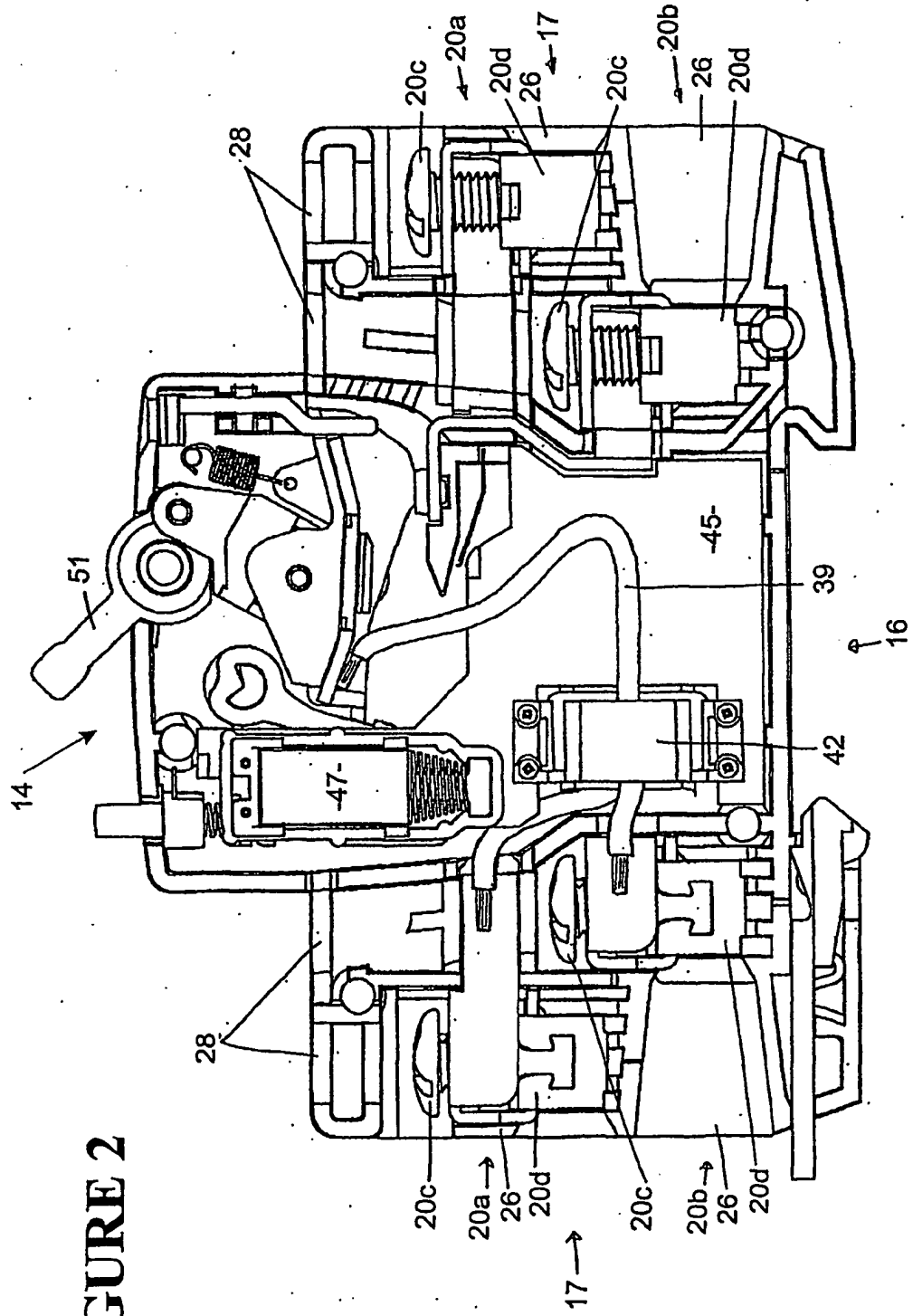
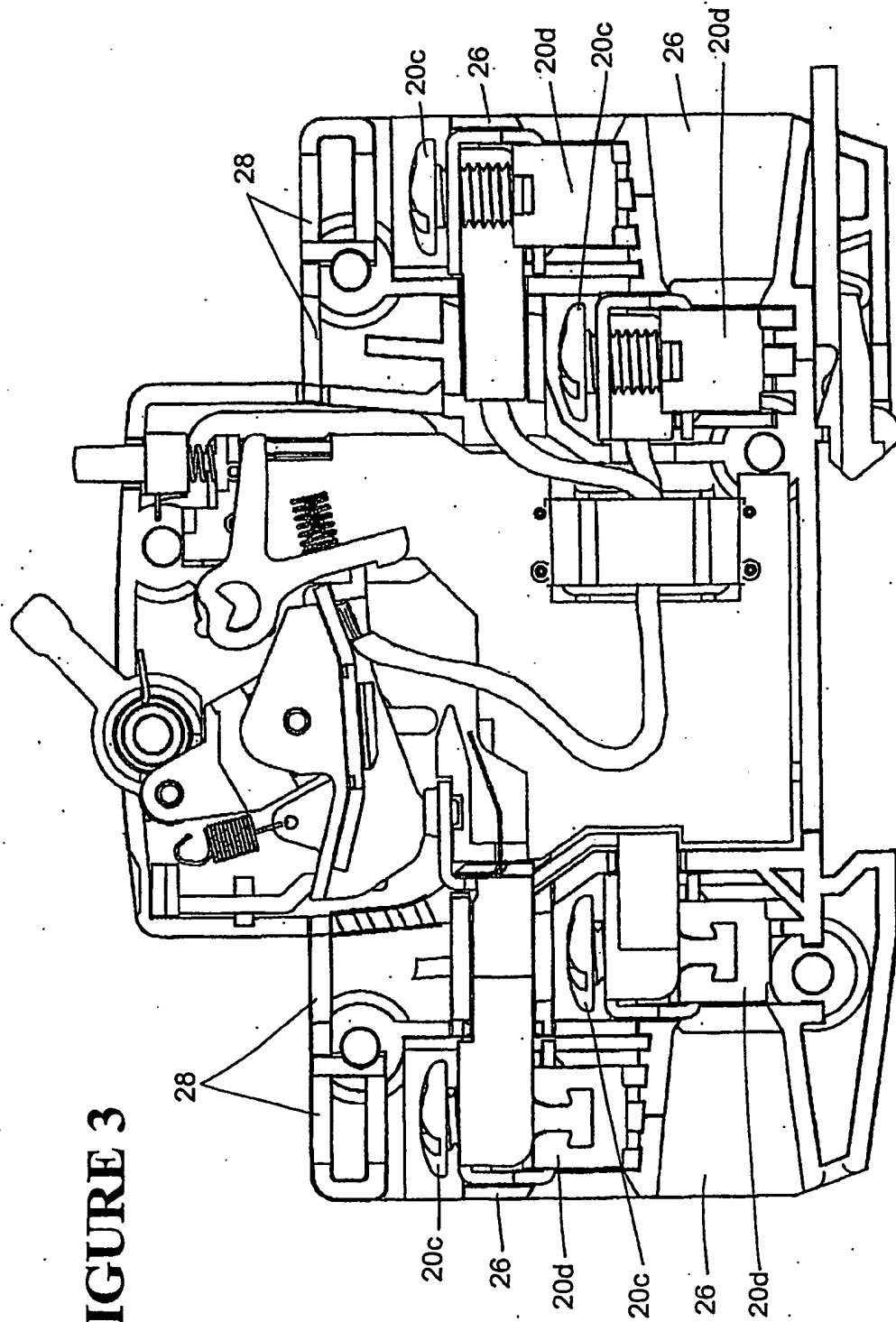


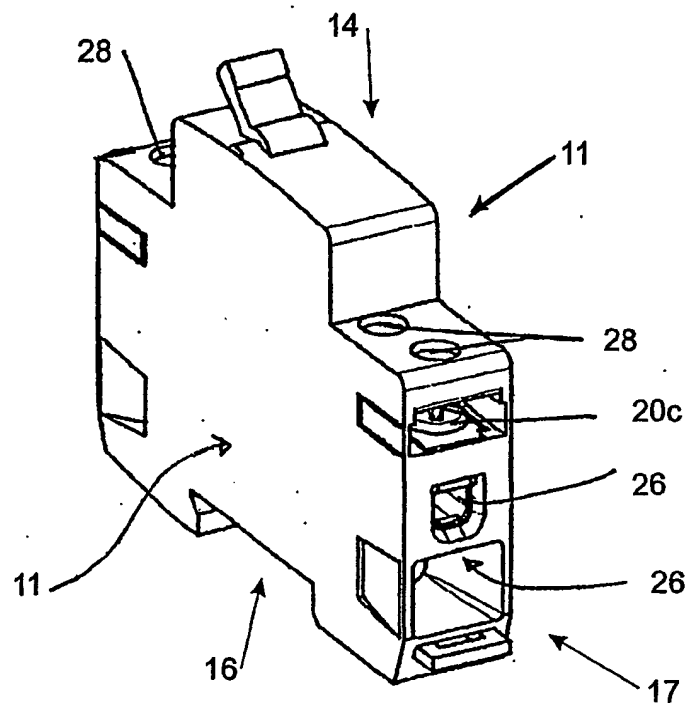
FIGURE 2

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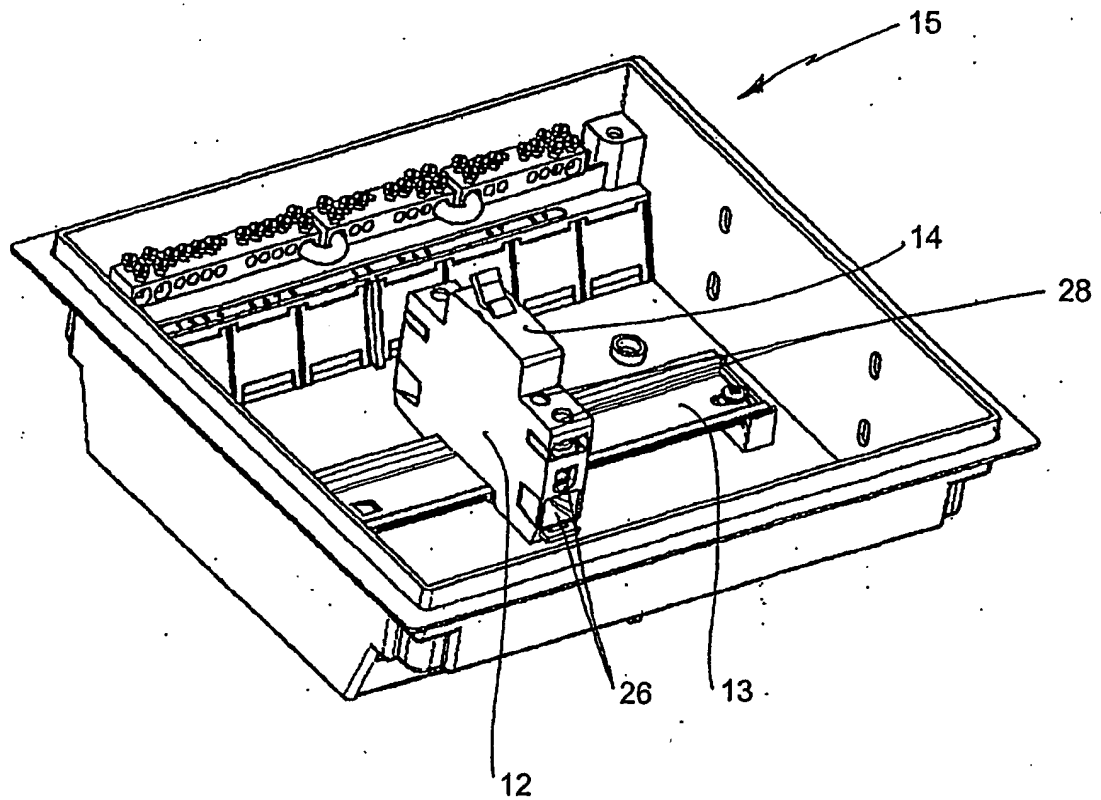


**FIGURE 3**

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**FIGURE 4**

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**FIGURE 5**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ02/00049

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>  |  |  |
|---|--|--|
| Int. Cl. 7: H02H 3/08, H01H 73/02   |  |  |
| According to International Patent Classification (IPC) or to both national classification and IPC   |  |  |
| <b>B. FIELDS SEARCHED</b>   |  |  |
| Minimum documentation searched (classification system followed by classification symbols)   |  |  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched   |  |  |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  |  |  |
| DWPI, IPC H01H 71/-, 73/-, H02H 3/00, 5/00 and Keywords (terminal, position, different, adjacent) and similar terms   |  |  |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>   |  |  |
| Category*   | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.  |
| X   | WO 92/02065 A (SQUARE D COMPANY) 6 February 1992<br>See whole document, particularly figures (items 26,28)   | 1-14   |
| X   | Derwent Abstract Accession No. 99-091626/08, Class X13,<br>JP 10326555 A (NITTO KOGYO KK) 8 December 1998,<br>See abstract and figure (items 5)                        | 1,3-6,8-14   |
| X   | Derwent Abstract Accession No. 98-198857/18, Class X13,<br>JP 10050192 A (MATSUSHITA ELECTRIC WORKS LTD) 20 February 1998,<br>See abstract and figure (items 41,42,65) | 1,3-6,8-14   |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex   |  |  |
| <p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |  |  |
| Date of the actual completion of the international search<br>1 August 2002  |  | Date of mailing of the international search report<br>7 AUG 2002         |
| Name and mailing address of the ISA/AU<br>AUSTRALIAN PATENT OFFICE<br>PO BOX 200, WODEN ACT 2606, AUSTRALIA<br>E-mail address: pct@ipaustalia.gov.au<br>Facsimile No. (02) 6285 3929  |  | Authorized officer<br><br>STEPHEN CLARK<br>Telephone No : (02) 6283 2781 |



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ02/00049

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |   |                       |
|---|---|-----------------------|
| Category*   | Citation of document, with indication, where appropriate, of the relevant passages    | Relevant to claim No. |
| A   | US 6232857 B (MASON Jr, et al) 15 May 2001<br>See abstract and figure 1 (items 18,20) | 1-14                  |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NZ02/00049

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in<br>Search Report |          | Patent Family Member |             |
|---|----------|----------------------|-------------|
| WO  | 92/02065 | CA 2066629           | EP 491933   |
|   |          | US 5179491           | MX 9100297  |
| JP  | 10326555 | NONE                 |             |
| JP  | 10050192 | NONE                 |             |
| US  | 6232857  | AU 73741/00          | WO 01/20634 |
| END OF ANNEX                              |          |                      |             |